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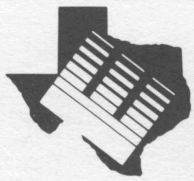

**Texas
Agricultural
Extension
Service**

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Pollution Control for Dairy Farms

POLLUTION CONTROL FOR DAIRY FARMS

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Nuisance conditions and water and air pollution from dairies can be minimized or avoided by proper site selection and facility design. The design of dairy waste management systems is strongly influenced by state and federal pollution control regulations, summarized here.

State Water Pollution Control

The Texas Water Quality Act of 1967, as amended, states that no person or operation without a permit from the Texas Department of Water Resources (TDWR) can handle waste in any manner that causes a discharge of pollutants. Under this act, the TDWR issues water pollution abatement permits to those dairies the agency believes may cause water pollution. A permit does not become mandatory when a dairy operation reaches a specific number of head. However, dairies with more than 250 cows in the milking herd are usually required to obtain a state water pollution control permit.

To obtain a permit from the Texas Department of Water Resources, dairies must install manure and wastewater management systems to prevent discharge. This generally requires two types of systems: runoff control and manure management. The manure management system is usually most important because highly concentrated wastewater is produced daily in the milking center and can result in a chronic discharge if not controlled. Contaminated runoff from open lot areas occurs intermittently. Recommendations to achieve no-discharge are presented here.

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Manure Management Systems

Liquid manure should be collected, stored and disposed of on land to prevent direct or indirect discharge into streams. Liquid manure management systems ordinarily consist of concrete storage tanks or lagoons, followed by terminal disposal of manure or treated effluent on land using irrigation or field-spreading equipment. According to the TDWR, storage tanks or treatment lagoons should be large enough to store at least 30-days accumulation of manure and waste water, but there are exceptions. For example, the TDWR may approve smaller liquid manure storage tanks (7 to 15 days storage) if the unit can be emptied by irrigation or tank wagon equipment at twice the rate that manure and waste water accumulate. Construction details for liquid manure storage tanks are available from county Extension agents.

To control odors and flies, manure treatment lagoons should be much larger than the 30-day minimum capacity the TDWR requires. The primary lagoon should have a liquid capacity of 3 to 4 cubic feet per pound of liveweight served. This results in 150 to 360 days storage capacity, depending upon wash water usage. The second-stage lagoon should have approximately 1.5 cubic feet capacity per pound of liveweight served plus enough freeboard to store direct rainfall into both lagoons.

Manure in solid or liquid form can be disposed of on soils at rates approximately equal to the plant requirements for nitrogen. At these application rates, surface and groundwater will not be polluted under most conditions. The nitrogen requirement can be determined from a soil test, available through your county Extension agent. The concentrations of nutrients in dairy

Table 1. Dry tons of dairy manure needed to supply 100 pounds of available nitrogen over the cropping year[1,2]

Length of time applied	Nitrogen content of manure, percent dry basis					
	1.0	1.5	2.0	2.5	3.0	4.0
Years	----------Tons dry manure per 100 lb N----------					
1	22.2	11.6	7.0	4.6	3.1	1.4
2	15.6	9.0	5.8	3.9	2.8	1.4
3	12.7	7.7	5.1	3.6	2.6	1.4
4	11.0	6.9	4.7	3.4	2.5	1.3
5	9.8	6.3	4.4	3.2	2.4	1.3
10	6.9	4.9	3.7	2.8	2.2	1.3
15	5.6	4.2	3.3	2.6	2.0	1.2

[1]The values are for repeated application on the same acreage.

[2]Gilbertson, C. B., F. A. Norstadt, A. C. Mathers and others, 1979. *Animal Waste Utilization on Crop and Pastureland: A Manual for Evaluating Agronomic and Environmental Effects.* URR 6, United States Department of Agriculture, Washington, D. C.

manure can be determined by certain commercial analytical laboratories in Texas.

A guide to determining proper manure application rates was developed by the United States Department of Agriculture (USDA) Southwestern Great Plains Research Center at Bushland, Texas. This method takes into account the rate of release of available nitrogen in manure. Recommended manure application rates are shown in Table 1.

As an example, suppose dairy manure contains 2.0 percent nitrogen on a dry matter basis. As shown in Table 1, it takes 7.0 tons of manure (dry basis) the first year to supply 100 pounds of available nitrogen per acre. In succeeding years, release of residual organic nitrogen lowers the manure requirement to 5.8 tons per acre the second year and 4.4 tons per acre the fifth year.

Also consider nitrogen losses after manure is applied to soil. Increase application rates (tons per acre) from Table 1 by approximately one-third when manure is to be applied to the soil surface rather than incorporated into the soil.

Runoff Control Systems

To meet the TDWR no-discharge requirement, collect runoff from areas of animal *confinement* and dispose of it on land. Confinement generally applies to corrals, pens or holding areas in which high cattle density and trampling prevents growth of vegetation on the soil surface.

Design and manage the runoff control system in this manner:

- Divert outside runoff and roof drainage around the confined portion of the dairy to minimize contaminated runoff. Keep cattle holding lots and loafing areas as small as practical to reduce the volume of contaminated runoff.
- Route runoff from open feed pens or holding pens through a basin or flat settling channel for solids removal. By this means, at least 70 percent of the settleable manure solids transported by runoff can be removed. Removal of solids from settling basins or channels preserves the holding pond capacity, reduces odors during pond dewatering and concentrates solids for easy collection and utilization in the soil and plant system.

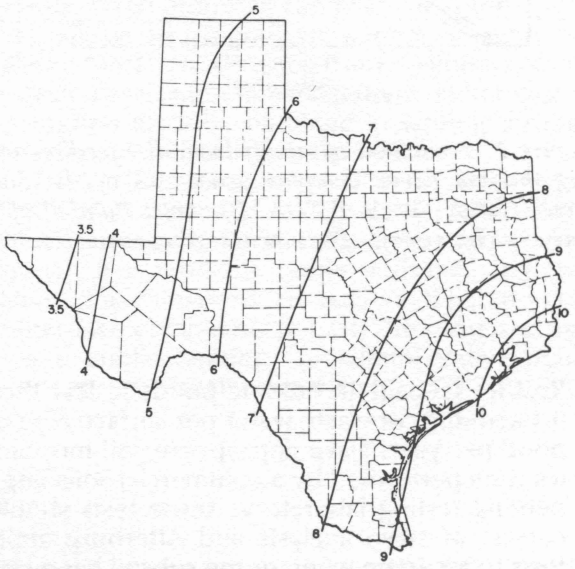

Figure 1. Magnitude of 25-year frequency, 24-hour duration rainfall (inches) for designing runoff holding ponds according to TDWR and EPA standards.

- Collect all manure-contaminated runoff in holding ponds. According to the TDWR, these holding ponds must be large enough to temporarily store all runoff from the 25-year frequency, 24-hour duration rainfall event (Figure 1), plus a 30-day accumulation of any manure or wastewater which could drain into the facility. The design volume of runoff to be handled (acre-inches per acre of feedlot surface) can be determined from Figures 1 and 2. The runoff depth (inches) will always be at least 75 percent of the rainfall depth (inches).
- Within 14 days after rainfall, or any time the holding ponds become more than 25 percent full, dewater them by irrigation onto pasture or crop land. Evaporation ponds designed to withstand the 10-year period of maximum recorded rainfall less normal evaporation losses may be a practical alternative in west Texas.

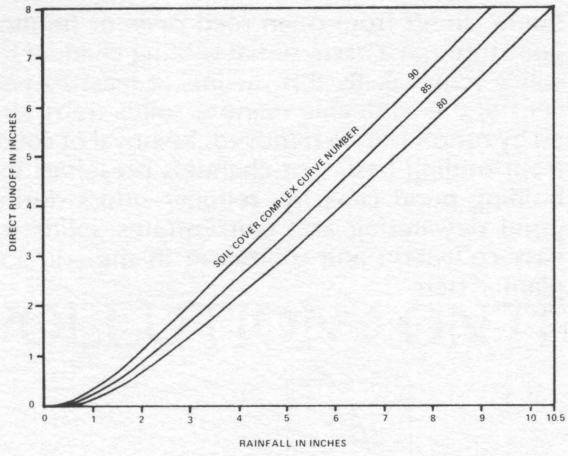

Figure 2. Prediction of runoff from dirt feedlots using the soil cover complex procedure of the Soil Conservation Service-USDA. Example: Rainfall of 7 inches yields runoff of 5.9 inches using curve No. 90.

- Restrict seepage in holding ponds to less than 0.1 acre-foot of waste water per surface acre of pond per year. Have appropriate soil mechanics tests performed by a commercial soils engineering testing laboratory. These tests should consist of sieve analysis and Atterburg limits tests to ascertain whether the subsoil has a clay loam or clay texture. Soil test results should meet the following TDWR criteria:
  - — Thirty percent or more passing No. 200 screen,
  - — Thirty percent or more liquid limit,
  - — Fifteen percent or more plasticity index.
- Remove settled solids from drainage ditches, settling channels and holding ponds whenever such facilities are as much as 20 percent full of solids. Distribute these solids on land.

Federal Water Pollution Control

The 1972 Federal Water Pollution Control Act, as amended by the 1977 Clean Water Act, requires operators of "point sources" of water pollution to obtain a federal permit. The United States Environmental Protection Agency (EPA) issued regulations in 1976 which classify a "concentrated animal feeding operation" as a point source needing an EPA permit if it discharges wastewater to navigable waters. EPA considers a dairy operation a point source if:

- Animals are kept in open lots or buildings at least 45 days per year; and
- Animal density on open lots is such that growth of crops or forage is not sustained over any portion of the lot or facility; and
- The operation has more than 700 mature dairy cows, including milkers and dry cows and it discharges off-premises; or
- The operation has more than 200 mature dairy cattle and discharges either
  - — to a stream that flows through or alongside the operation; or
  - — through a man-made conveyance, such as a ditch, pipe or flushing system.

Smaller dairies may also be required to obtain a permit if they have substantial potential for water pollution.

Under the EPA regulations, a dairy operation without a discharge does not need a permit. An operation is considered to discharge if manure-contaminated wastewater will leave the premises under rainfall conditions less than the 25-year frequency, 24-hour duration storm as defined in Figure 1. A dairy operator is not held responsible for discharges which occur because of rainfall events higher than the 25-year, 24-hour storm.

The EPA and the TDWR have very similar water pollution control regulations for dairy operations. Under the EPA regulations, a feeding operation without a discharge does not need a permit. A Texas dairy producer who complies with the state (TDWR) requirements, controls discharge and obtains a permit if required, does not need to obtain a federal (EPA) permit.

State Air Pollution Control

The Texas Air Control Board (TACB) regulates odors from dairies under a general nuisance regulation. Nuisances are handled on an individual complaint basis. Texas dairies have seldom caused severe odor problems, probably because of the cleanliness required around the milking parlor and corrals, the large space allowance per head and frequent manure removal.

The TACB requires a new dairy to obtain a construction permit if it will have more than 1,000 cattle of any size. Dairies expanding by 100 percent or more which will reach a capacity of 1,000 head or more are also required to obtain permits.

An operating permit must be applied for within 60 days after dairying operations start. Each permit requires a public notice be issued, with 30 days allowed for public comment. A public hearing may be required.

Under the permit program, the TACB is interested mainly in the location of the proposed facility with respect to neighbors and to prevailing winds (Figure 3). The agency considers operating factors and manure management systems that may increase or decrease odor intensity, frequency, duration and offensiveness.

Some general measures to reduce odor nuisance potential are:

- Maintain good pen drainage at all times, either by uniform slopes of 2 to 4 percent or by constructing permanent mounds in flat pens.
- Collect manure from confinement buildings at least once daily.
- Store liquid manure either in covered underground tanks, above ground structures or correctly sized manure treatment lagoons.
- Agitate liquid manure storage tanks or lagoons when the wind is blowing away from nearby neighbors.
- Apply liquid manure or lagoon effluent to fields when the wind direction and atmospheric conditions are favorable. Generally, odors disperse more rapidly at midday when the earth is heating than in the late afternoon or evening when calm, cooler conditions prevail.
- Dispose of runoff water collected in holding ponds as soon as weather conditions permit.
- Dispose of dead animals within 48 hours.

Most new or expanded dairy operations can obtain an *exemption* from the TACB construction permit program. An exemption is granted if the operation will be an insignificant source of air contaminants (odors). There are two types of exemptions. A specific exemption is granted automatically if the operation will house fewer than 1,000 dairy cattle. A special exemption can be granted if the producer can justify that the operation will be an insignificant source of odors because of location, distance from neighbors, facility design and manure management. Either type of exemption must be obtained in writing through the executive director of the TACB.

The TACB also regulates odors from dairy facilities under a *general nuisance regulation.* Individual complaints are investigated by agency personnel. If a probable public nuisance is determined, the dairy producer may need to correct it. If nuisance complaints persist, the producer may face a public hearing, an administrative board order and eventually a civil suit.

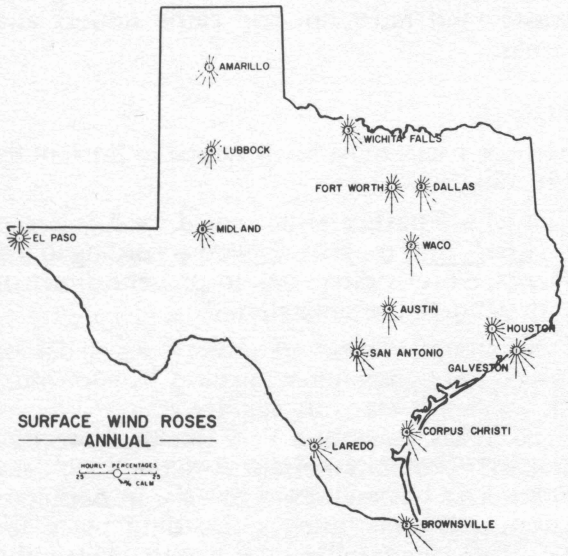

Figure 3. The percentage of time the wind blows from each direction annually is shown in this windrose diagram.

Other Odor Control

Local government entities can sue for odor nuisance in a district court under the Texas Clean Air Act. Local agencies may also bring suit in a county court (under Article 4477-5b, VATS) against an operation that causes air pollution, including odors. Air pollution is punishable by a maximum fine of $1,000 per day of violation.

The 1945 Texas Sanitation and Health Protection Law regulates nuisances relating to sanitation and public health. Investigation of odor complaints to local health authorities or the Texas Department of Health sometimes leads to the discovery of improper sanitation practices with public health implications. Correction of these practices may solve the odor problem.

Finally, dairy producers are subject to private nuisance lawsuits brought by neighbors without involvement of government agencies. The term *nuisance* is defined legally as, "any condition or action which interferes with the normal use and enjoyment of property". Private nuisance suits are explained in detail in Extension publication L-1449, *Odor Regulation by Nuisance Laws.*

The 1981 Texas Right-To-Farm Law grants agricultural operations limited immunity from nuisance lawsuits filed either by public agencies or

private parties. Under this law, an agricultural operation cannot be declared a nuisance if: (1) it has been in existence for at least 1 year and (2) it complies with the existing environmental protection statutes and regulations. This limited protection extends even to agricultural operations annexed into a municipality.

State Milk Inspection

The Texas Department of Health operates a rigorous milk inspection program to insure dairy sanitation. This program regulates dairy waste management practices. The Texas Milk Grading and Labeling Law, as amended in 1979, authorized the Texas Department of Health to establish a statewide dairy and milk inspection program and to issue permits to dairies.

To obtain a permit under the Texas Milk Grading and Labeling Law, dairy producers must meet waste management requirements of the state milk inspection regulations, adopted in July 1980, by the Texas State Board of Health. These regulations were derived from the 1978 Federal Grade A Pasteurized Milk Ordinance.

Milk Sanitation Regulations

The manure management requirements of the state milk inspection regulations are:

Milking Parlor and Milkroom

- The milking parlor and milkroom must have impervious (concrete) floors and smooth-finished walls which can be cleaned easily.
- Floors and gutters must be graded and maintained for good drainage.
- Interior surfaces of the milking parlor and holding shed (including floors, walls, equipment and pipelines) must be kept clean and manure-free.
- Liquid wastes from the milkroom must be collected in accessible floor drains and disposed of in a sanitary manner. If connected to a sanitary (municipal) sewer system, a trap must be provided between the drain and the sewer to prevent backflow of noxious gases.
- Water supply wells cannot be closer than 50 feet from any "pit, privy, septic tank or accumulated manure," or closer than 100 feet from any "cesspool, seepage pit or subsurface disposal field".
- Drains or pipes carrying animal wastes or sewage cannot be placed within 10 feet of water wells or water pipes.
- Air circulation must be sufficient to minimize odors within the milking parlor and to prevent condensation on interior surfaces.

Free-Stall Area, Stable

- Manure and soiled bedding must be removed from free-stall barns daily.
- Space allotment in bedded areas must be at least 50 square feet per head.

Corrals and Holding Lots

- Space allotment in exercise yards must be at least 100 square feet per head.
- Standing water or liquid wastes are not allowed on corral surfaces. The cowyard, including open or enclosed corrals or housing areas adjacent to the milking barn, must be graded for good drainage. Depressions and soggy areas, including approaches to the milking parlor and to feeding and watering facilities, must be backfilled to prevent pooling of water or wastes.
- Cow lanes must be kept reasonably dry with manure removed daily.
- Manure packs must be well drained and provide a reasonably firm footing for cattle.
- Manure and soiled bedding shall be removed (or clean bedding added) at sufficiently frequent intervals to prevent soiling of the cows' udders and flanks. Manure must be removed from exercise yards daily.
- Solid manure storage piles must be inaccessible to the animals. Stored manure, bedding and waste feed must not soil cattle udders and flanks.

Fly Control

- Manure packs must be managed to prevent fly breeding.
- Only those pesticides approved for dairies can be used. They must be applied according to the manufacturer's directions to prevent direct or indirect milk contamination.

These requirements are uniform for all dairies in Texas, but their interpretation by individual milk inspectors may vary slightly.

The Texas Sanitation and Health Protection Law (1945) prohibits nuisances defined as, "any condition or place allowed to exist in populous areas which constitutes a breeding place for flies". This law granted local health officers the authority to refer persistent violators to the local prosecuting attorney for legal action.

Related Extension Publications

L-1053 *Feedlot Runoff Disposal on Grass or Crops*

L-1094 *Manure Management for Cattle Feedlots*

L-1100 *Control of Flies around Feedlots*

L-1188 *Chemical Control of Manure Odor*

L-1198 *Consider Prevailing Winds in Feedlot Site Selection*

L-1220 *Fertilization of Crops with Feedlot Wastes on the Texas High Plains*

L-1449 *Odor Regulation by Nuisance Laws*

Sources of Additional Information

- Texas Department of Water Resources, P. O. Box 13087, Capitol Station, Austin, Texas 78711.
- Texas Air Control Board, 6330 Highway 290 East, Austin, Texas 78723.
- Texas Department of Health, Division of Milk and Dairy Products, 1100 West 49th Street, Austin, Texas 78756.
- County and area offices of the Texas Agricultural Extension Service, The Texas A&M University System.
- County and area offices of the Soil Conservation Service — United States Department of Agriculture.

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